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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,757	06/15/2001	Kiyotaka Wasa	35.C15462	5938

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EXAMINER	
TUGBANG, ANTHONY D	
ART UNIT	**PAPER NUMBER**
3729	

DATE MAILED: 11/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/880,757	WASA ET AL.	
	Examiner	Art Unit	
	A. Dexter Tugbang	3729	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 September 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *73-75 and 77-85* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *73-75 and 77-85* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/9/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on September 2, 2005 has been entered.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 103

3. Claims 73, 74, 77-81 and 83-85 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Moynihan et al 5,500,988, Roeder et al 5,719,417, and Farrey et al (IEEE Publication entitled "Growth and Characterization of...Single Crystal Piezoelectric), referred to hereinafter as Farrey.

Regarding Claim(s) 73 and 84, Moynihan discloses a method of manufacturing a piezoelectric element comprising: forming on a support substrate 10 (in Fig. 1), a layer or first layer (bottom PZT layer 3 in Fig. 1) having a perovskite structure and a second layer (anyone of PZT layers 3 above the bottom "first layer") having a perovskite structure and zirconium (see col. 1, lines 14-16); forming the first and second layers to 800 °C with both layers having amounts of zirconium (see col. 4, lines 31-37); and subsequently cooling from the formation temperature of 800 °C to normal room temperature (see col. 3, lines 29-42).

The range of cooling of Moynihan, i.e. from 800 °C to normal room temp., overlaps the claimed range of "at least to 450 °C". The cooling speed of Moynihan can be calculated to approximately 1560 °C/min, which satisfies the claimed speed of "at least 30 °C/minute".

Regarding Claim(s) 74, the claimed "intermediate layer" can be read as anyone of the PZT layers 3 of Moynihan in-between the selected first and second layers.

Regarding Claim(s) 79-81, the claimed "piezoelectric film" of Moynihan can be read as either the first or second layers 3 with each being formed of zirconium in a layer thickness range of 1-25 μm (see Claim 1), which overlaps the claimed ranges of the piezoelectric film as recited in each of Claims 79-81.

Regarding Claim(s) 83, the limitations of claim 83 are very similar to the limitations of Claim 73 with the exception of the claimed "element for preventing crystallization growth during a thin film process". The claimed "element for preventing crystallization growth during a thin film process" (line 6) is alternatively read as the material of zirconium in Moynihan.

Regarding Claim(s) 85, Moynihan further teaches that the substrate is heated along with the temperature of the layer or first layer (see col. 3, lines 29+). Thus, the heating temperature is the temperature of the supporting substrate.

With respect to Claims 73, 74 and 83-85 and the process being drawn to "a piezoelectric single crystal film or a piezoelectric single orientational crystal film", these limitations now being recited in the preamble of each Claims 73, 83 and 84 are considered to be intended use limitations and have not been given patentable weight in Claims 73, 74 and 83-85, since the body of Claims 73, 74 and 83-85 do not depend upon the preamble for completeness and the process steps here are able to stand alone. *In re Hirao*, 535 F.2d 67 190 USPQ 15 (CCPA 1976).

Moynihan does not mention that a layer is formed by a vapor method (as required by Claim 84), or does not mention that both the first layer and the second layer are formed by a vapor method with the first layer containing either no zirconium or an amount of zirconium less than the second layer (as required by Claims 73 and 83).

Roeder teaches a PZT forming process of forming a layer, or first layer, of a pervoskite structure (seed layer 37 in Fig. 3), then subsequently forming a second layer (PZT layer 40 in Fig. 4), which is also of a pervoskite structure, by a vapor method of chemical vapor deposition. The first layer is formed of a composition without any zirconium (PLT) and the second layer is formed of a composition including zirconium (see col. 4, line 65 to col. 5 line 5 and col. 6, lines 9+). Within this vapor method of vapor deposition, both the first and second layers are heated at a time of formation above 500°C (see col. 7, lines 28-35).

Regarding Claim(s) 77 and 78, Roeder suggests that the piezoelectric film (either one of layers 37 or 40) can have a monocrystal lattice structure, or at least a "piezoelectric single crystal" structure of either a (100), or a (111) orientation (see col. 7, lines 65+ and Fig. 12).

The benefit of the above PZT forming process of Roeder positively allows control of the orientation of the layers of the piezoelectric element during operation (see col. 1, lines 31-49). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the method of Moynihan by utilizing the PZT forming process of Roeder by forming one of the layers without zirconium, to advantageously control the orientation of the layers of the piezoelectric element.

Further regarding each of Claims 77-81, the limitations in each of the claims recite the claimed "piezoelectric film" as these limitations would further limit the preamble of Claims 73,

83 and 84. It is also noted here that Roeder specifically mentions that the "piezoelectric film" is a rhombohedral crystalline lattice structure (see Abstract).

The examiner takes Official Notice that rhombohedral crystalline lattice structures are conventional in the art of piezoelectrics and are well known to be "piezoelectric single crystal film(s)". As evidence of obviousness, the examiner cites the IEEE Publication to Farrey as Farrey explains that rhombohedral crystalline lattice structures can have orientations in either the directions of (100) or a (111) to have more efficient electrical-mechanical energy conversions of the piezoelectric film during operation (see Abstract of Farrey).

Thus, alternatively, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized the piezoelectric film of either one of Moynihan or Roeder as a conventional and well known lattice structure of a piezoelectric single crystal, for at least the benefits of having more efficient electrical-mechanical energy conversions of the piezoelectric film during operation.

4. Claim 75 is rejected under 35 U.S.C. 103(a) as being unpatentable over the prior art above, as applied to claim 73, and further in view of EP'165.

Moynihan, as modified by Roeder, discloses the claimed manufacturing method as previously discussed. The modified Moynihan method does not teach the ratio of zirconium/titanium.

EP'165 teaches at least one example of a zirconium/titanium ratio of 50/50 (see col. 8, lines 54-56). The advantage of the EP'165 manufacturing process provides high piezoelectric characteristics with thin piezoelectric films (see col. 2, lines 8-12).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the method of Moynihan by including the ratio EP'165, to advantageously provide high piezoelectric characteristics with thin piezoelectric films.

5. Claim 82 is rejected under 35 U.S.C. 103(a) as being unpatentable over the prior art above, as applied to Claim 73, and further in view of Dawson et al 5,453,262.

Moynihan, as modified by Roeder, discloses the claimed manufacturing method as previously discussed. The modified Moynihan method does not teach that the second layer contains niobium, tin and manganese.

Dawson teaches that material selection of a PZT for a piezoelectric film can include the specific materials of niobium, tin and manganese (see col. 4, lines 28-34) as this material selection would inherently provide antiferroelectric characteristics. The selection of the above materials alternative forms a perovskite structures (see col. 3, lines 5+).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the material of the second layer of Moynihan by including the material selection of Dawson, to achieve an art recognized equivalent perovskite structure.

Response to Arguments

6. The applicant(s) arguments filed on September 2, 2005 have been fully considered, but have not been deemed to be found as persuasive.

In regards to the merits of the prior art, the applicant(s) urge that none of the references applied above teach a step of forming by a vapor method on a supporting substrate a first layer having a perovskite structure, a temperature at a time of formation of the first layer being at least

500 °C during the vapor method, and a step of subsequently cooling from the formation of the temperature at least to 450 °C with a cooling speed of at least 30 °C/minute, as required in each of Claims 73, 83 and 84.

The examiner most respectfully disagrees. The limitations in question above were relied upon in the combination of at least Moynihan et al and Roeder et al and in response to the applicant(s) arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

The applicant(s) further argue that the combination of references expressed in the rejections above are: 1) not proper; and 2) the cited motivation is not valid. The examiner wishes to clarify that the modification of Moynihan would include adding the seed layer of Roeder. The examiner's position is that the intended use or intended purpose are the same for both Moynihan et al and Roeder et al as each is solving the problems associated with achieving particular piezoelectric properties within a device with the use of multiple layers of PZT. Adding the seed layer of Roeder has the benefit of manipulating or controlling the film orientation of the PZT layers (see Roeder at col. 2, lines 47+ and col. 1, lines 25-51). Further regarding the cooling aspects of Roeder, the layers of Roeder are subsequently cooled at least to the extent of normal atmospheric conditions being that the device of Roeder is not to operate at temperatures above 500 °C.

So the examiner's position is that the combination of the references above are proper and valid to one of ordinary skill in the art of manufacturing piezoelectric element structures, each solving the very same problems associated with multiple PZT layers.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to A. Dexter Tugbang whose telephone number is 571-272-4570. The examiner can normally be reached on Monday - Friday 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Peter Vo can be reached on 571-272-4690. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A. Dexter Tugbang
Primary Examiner
Art Unit 3729

November 10, 2005